IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of

SUGIYAMA — Atty. Ref.: 2635-16

Serial No. 09/873,287 — TC/A.U.: 1753

Filed: June 5, 2001 — Examiner: Olsen

For: MULTILAYERED GAS SENSING ELEMENT EMPLOYABLE IN AN EXHAUST SYSTEM OF AN INTERNAL COMBUSTION ENGINE AND MANUFACTURING METHOD THEREOF

* *

May 10, 2007

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOTIFICATION OF NON-COMPLIANT APPEAL BRIEF

Sir:

Responsive to the Notification of Non-Compliant Appeal Brief mailed May 4, 2007, a corrected Appeal Brief, which corrects the typographical error in Section VI, page 8, of the originally filed Appeal Brief, noted in the Notification of Non-Compliant Appeal Brief, is attached.

An early and favorable consideration is solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

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CORRECTED APPEAL BRIEF

Sir:

Applicant submits herewith their Brief on Appeal pursuant to 37 CFR §41.37.

TABLE OF CONTENTS

(I) REAL PARTY IN INTEREST

The real party in interest is the assignee, DENSO CORPORATION, a corporation of Japan.

(II) RELATED APPEALS AND INTERFERENCES

On information and belief there are no other prior or pending appeals, interferences, or judicial proceedings (past or present), known to appellant, the appellant's legal representative, or assignee, which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(III) STATUS OF CLAIMS

Claims 1-6 and 14 remain pending. Claims 1-6 and 14 have been rejected. The rejection of claims 1-6 and 14 is being appealed. A current listing of claims that are the subject of this Appeal is presented in the Claims Appendix of this Brief.

(IV) STATUS OF AMENDMENTS

A Request for Reconsideration under Rule 116 was filed on December 8, 2006 in response to the Examiner's final rejection of September 19, 2006. On January 12, 2007, the Examiner issued an Advisory Action advising that the Request for Reconsideration had been considered but did not place the application in condition for allowance.

(V) SUMMARY OF CLAIMED SUBJECT MATTER

The present invention helps assure sufficient bonding strength at the bonding boundary between a solid electrolytic sheet containing zirconia and yttria and an insulating sheet containing alumina in a multilayered gas sensing element.

Thus and more specifically, as defined in claim 1, the sole independent claim of this application, the invention provides a multilayered gas sensing element 1 for incorporation into a gas sensor installed in an exhaust system of an internal combustion engine, the multilayered gas sensing element comprising: laminated layers comprising at least one solid electrolytic sheet 11 containing zirconia and yttria and at least one insulating sheet 13 containing alumina; a crystal phase 101 containing silicon dioxide which intervenes between said solid electrolytic sheet and said insulating sheet at least at a part of a bonding boundary between said solid electrolytic sheet and said insulating sheet; and a heater 2 directly attached to a side surface of said insulating sheet 13 to transfer heat generated in said heater to said insulating sheet 13 and said solid electrolytic sheet 11, wherein said solid electrolytic sheet 11 and said insulating sheet 13 having said heater are laminated and sintered such that the crystal phase is liquefied during the sintering so as to generate material transfer between said sheets via the liquefied crystal phase and such that the material transfer causes said sheets to be integrally bonded with each other. (Page 5, lines 12-23; Page 7, lines 27 - Page 8, line 8; Page 12, lines 8-12 and 17-19; and Page 18, lines 9-15).

(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 2, 4-6 and 14 stand rejected under 35 USC §103(a) as being unpatentable over Tatumoto et al in view of either Kobayashi et al or Nanataki et al with or without evidence from the instant invention or Fujishiro et al.

Claim 3 stands rejected under 35 USC §103(a) as being unpatentable over Tatumoto et al in view of either Kobayashi et al or Nanataki et al as applied to claim 1 and further in view of Ishiguro et al.

Claim 5 stands rejected in the alternative under 35 USC §103(a) as being unpatentable over Tatumoto et al in view of Kobayashi et al and Nanataki et al as applied to claim 1 and further in view of JP 9-26409.

Claim 6 stands rejected in the alternative under 35 USC §103(a) as being unpatentable over Tatumoto et al in view of Kobayashi et al and Nanataki et al as applied to claim 1 and further in view of JP 08-114571.

(VII) ARGUMENT

A. Claims 1, 2, 4-6 and 14 are patentable as not having been obvious from Tatumoto et al in view of either Kobayashi et al or Nanataki et al with or without evidence from the instant invention or Fujishiro et al.

The present invention provides a multilayered gas sensing element having at least one solid electrolytic sheet and at least one insulating sheet. The solid electrolytic sheet contains zirconia and yttria and the insulating sheet contains alumina. These ceramic sheets are laminated with one another. Because the materials comprising the ceramic sheets differ from one another, applicant has recognized that it is necessary and desirable to strengthen the bond between the ceramic sheets. To strengthen the bond, applicant provides a gas sensing element wherein a crystal phase containing silicon dioxide is formed between the ceramic sheets during the sintering operation. The silicon dioxide lowers the melting point of the crystal phase. More specifically, due to the incorporation of silicon dioxide, when the ceramic sheets are sintered, a liquefied crystal phase appears between the ceramic sheets. The crystal phase is formed by liquefying portions of the ceramic sheets that face one another, which in turn causes material transfer between the portions of the ceramic sheets. Thus, the components of the crystal phase, including silicon dioxide, are originally contained in the respective ceramic sheets. The liquefied phase is effective to generate material transfer between the portions of the ceramic sheets via the liquefied crystal phase. Because of this material transfer, the ceramic sheets are tightly bonded to each other following sintering.

The Examiner states that "Tatumoto does not explicitly disclose the use of silicon dioxide in the electrolyte". It is respectfully submitted that the Examiner's statement in this regard is misleading. Tatumoto does not merely "fail to explicitly" disclose the use of silicon dioxide. Tatumoto does not implicitly disclose silicon dioxide either. There is simply no teaching or suggestion whatsoever regarding the use of silicon dioxide, much

less any teaching of a crystal phase liquefied during sintering so as to generate material transfer as recited in applicant's independent claim 1.

The Examiner cites Kobayashi and Nanataki as teaching the use of silicon dioxide for modifying a thermal expansion coefficient and/or thermal shock resistance. It is respectfully submitted, however, that neither Kobayashi nor Nanataki provide any teaching or suggestion whatsoever with regard to the formation of a crystal phase containing silicon dioxide between a solid electrolytic sheet and an insulating sheet much less that during sintering the liquefied crystal phase generates material transfer between the solid electrolytic sheet and the insulating sheet.

Recognizing the above deficiencies of the Tatumoto, Kobayashi and Nanataki references with respect to the claimed invention, the Examiner cites Fujishiro as allegedly teaching a bonding crystal phase containing silicon dioxide. Applicant respectfully disagrees.

Fujishiro teaches a hermetic seal between an electrolyte cylinder 28 and a conductive member 32 or 34. The electrolyte cylinder 28 is formed of ZrO_2–CaO ceramic containing a minor amount of oxides such as SiO_2 and/or $A1_2O_3$. The hermetic seal is attained by preliminarily metallizing surfaces of the electrolyte cylinder 28 and thereafter soldering the conductive member thereto. To metallize the surface of ZrO_2–CaO ceramics, a paste containing a powdered material such as a mixture of Mo, Mn, Ti; W, MnO_2, and TiO_2 dispersed in an organic solvent is applied onto the surface of the ZrO_2 - CaO ceramics, and the electrolyte cylinder 28 is baked at a temperature of 1200 – 1600 ^{o}C in a hydrogen atmosphere containing steam therein to give a thin metallic coating on the surface of ZrO_2–CaO ceramics. To join the electrolyte cylinder 28 to the conductive member, the metallized region of the electrolyte cylinder 28 is plated with nickel, and the similarly plated conductive member is joined with the electrolyte cylinder 28 at the plated region by means of a silver-copper or gold-copper solder (see column

5, lines 1-32). The minor amount of oxides present in the ZrO_2–CaO ceramics are characterized as present as a secondary phase distinct from the ZrO_2–CaO ceramics and are said to exhibit strong affinity for the metallic coating (see column 5, lines 21-24).

Therefore, Fujishiro teaches the oxides such as SiO_2 and/or Al_2O_3 contained only in ZrO_2–CaO ceramics (not ceramic sheets containing zirconia and yttria), and teaches the oxides exhibiting strong affinity not for another ceramic sheet but for the metallic coating.

As is apparent from the foregoing Fujishiro fails to teach or suggest oxides such as SiO_2 incorporated in ceramic sheet(s) for strengthening a bond between two ceramic sheets, fails to teach oxides contained in a crystal phase, fails to teach oxides originally contained in two sheets to be bonded to each other, and fails to teach material transfer between ceramic sheets. In fact, Fujishiro's teachings do not even relate to ceramics containing zirconia and yttria. Furthermore, it is respectfully noted that in Fujishiro a paste is applied onto the surface of the ZrO_2–CaO ceramics, and the ZrO_2–CaO ceramics with the paste is baked to attach the contents of the paste to the ceramics (see column 5, lines 6-16). In contrast, in the present invention, a solid electrolyte sheet and an insulating sheet are sintered (or baked) without using any paste, so that the sheets are bonded to each other. Thus, Fujishiro does not provide the teachings lacking in the primary three references so as to render the claimed invention obvious.

In summary, the cited prior art does not provide any teaching or suggestion that the incorporation of silicon dioxide will strengthen a bond between adjacent ceramic sheets, in particular due to the formation of a crystal phase containing silicon dioxide and material transfer between the ceramic sheets.

For all the reasons advanced above, it is respectfully submitted that the prior art cited by the Examiner does not teach or suggest a multilayered gas sensing element

wherein a bond between a solid electrolytic sheet containing zirconia and yttria and an insulating sheet containing alumina can be strengthened by a crystal phase containing silicon dioxide formed therebetween during sintering whereby there is material transfer between the respective sheets being bonded.

Accordingly, reversal of the rejection of claims 1, 2, 4-6 and 14 and the claims dependent directly or indirectly therefrom is respectfully requested.

B. Claims 3, 5 and 6 are patentable as not having been obvious from Tatumoto et al in view of either Kobayashi et al and/or Nanataki et al and further in view of Ishiguro, JP '409 and/or JP '571.

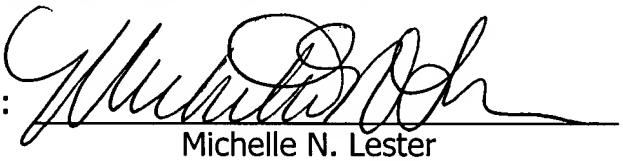
Claims 3, 5, and 6 are submitted to be patentable over the primary combination for the reasons advanced above. The Examiner's further reliance on Ishiguro, JP '409 and/or JP '571 does not overcome the deficiencies of the primary combination noted above.

CONCLUSION

For all the reasons advanced above, reversal of the Examiner's Rejection and allowance of all pending claims is solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 
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(VIII) CLAIMS APPENDIX

1. (Previously presented) A multilayered gas sensing element for incorporation into a gas sensor installed in an exhaust system of an internal combustion engine, the multilayered gas sensing element comprising:

laminated layers comprising at least one solid electrolytic sheet containing zirconia and yttria and at least one insulating sheet containing alumina;

a crystal phase containing silicon dioxide which intervenes between said solid electrolytic sheet and said insulating sheet at least at a part of a bonding boundary between said solid electrolytic sheet and said insulating sheet; and

a heater directly attached to a side surface of said insulating sheet to transfer heat generated in said heater to said insulating sheet and said solid electrolytic sheet,

wherein said solid electrolytic sheet and said insulating sheet having said heater are laminated and sintered such that the crystal phase is liquefied during the sintering so as to generate material transfer between said sheets via the liquefied crystal phase and such that the material transfer causes said sheets to be integrally bonded with each other.

2. (Previously presented) A multilayered gas sensing element as in claim 1, wherein said crystal phase further contains at least one component selected from the group consisting of: calcium oxide, magnesium oxide, barium oxide, and strontium oxide.

3. (Previously presented) A multilayered gas sensing element as in claim 1, wherein said bonding boundary between said solid electrolytic sheet and said insulating sheet is undulated.

4. (Previously presented) A multilayered gas sensing element as in claim 1, wherein said solid electrolytic sheet and said insulating sheet are directly bonded to each other at a remaining part of the bonding boundary, so that a crystal lattice of said solid electrolytic sheet is directly connected to a crystal lattice of said insulating sheet at the remaining part of said bonding boundary.

5. (Previously presented) A multilayered gas sensing element as in claim 1, wherein a thermal expansion coefficient difference between said solid electrolytic sheet and said insulating sheet is equal to or less than $2X10^{-6}$.

6. (Previously presented) A multilayered gas sensing element as in claim 1, wherein a sintering contraction coefficient difference between said solid electrolytic sheet and said insulating sheet is equal to or less than 3%.

Claims 7-13. (Canceled).

14. (Previously presented) The multilayered gas sensing element in accordance with claim 4, wherein a specific face of said crystal lattice of said solid electrolytic sheet specified by a Miller index of $(2\ \bar{1}\ \bar{1}\ 0)$ is directly connected to a specific face of the crystal lattice of said insulating sheet specified by a Miller index of (1 0 0).

Claim 15. (Canceled).

(IX) EVIDENCE APPENDIX

(NONE)

(X) RELATED PROCEEDINGS APPENDIX

(NONE)